“As long as our brain is a mystery, the universe, the reflection of the structure of the brain, will also be a mystery.”

(Santiago Ramón y Cajal, 1852-1934)

Overall learning goals

BIOC/NEUR 385; BIOC 585: Fundamentals of Neuroscience, Fall 2018

Fundamentals of Neuroscience will be a successful learning experience if we accomplish three major sets of learning goals. Specific learning objectives corresponding to these goals are extensively outlined in each of the study guides.

Goal 1: Be able to answer the question, how do the brain and neurons "work?"

How do neurons generate and conduct signals? How do neurons communicate? How and why do neurons and their connections change? What mechanisms support our ability to perceive external and internal stimuli? What mechanisms support our ability to move? Be able to articulate answers to these questions, explain the underlying mechanisms, and extract and apply general principles that govern them.

Goal 2: Be able to answer the question, how do we know how the brain and neurons "work?"

How did historically important experiments lead to our current understanding of the functions and plasticity of neurons and nervous systems? What major experimental strategies are currently employed to further our knowledge of neuroscience? Be able to explain the strategies, troubleshoot or critique an experiment, interpret or predict findings, and design experiments based upon established strategies.

Goal 3: Develop and/or reinforce a desire to learn more about the biology of the brain and nervous system, with the confidence that you can learn or do anything if you put the effort into it.

Achieve the satisfaction of learning by preparing in advance for each class, completing assignments and parts of assignments in a timely manner, learning from others and teaching others in group work, and learning to access reliable sources, including the primary literature.

Course Syllabus

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BIOC/NEUR 385 and BIOC 585 Fundamentals of Neuroscience

- **Syllabus details may be changed at any time at the discretion of the instructor.**
- **See the Course Summary at the bottom of this page for assignments in chronological order by due date**
- ***BIOC 585 STUDENTS:* Your syllabus is identical except for some additional assignments and how they are weighted (see"Bioc_585.pdf") in Files**

Meetings: MWF 10-10:50 am, location TBA

Instructor: David Caprette, caprette@rice.edu, ABL 327, x3498

Office hours: I hold office hours each week, however due to meetings and other obligations my hours are variable. Please see HERE (http://www.ruf.rice.edu/~bioslabs/bios415/Office_hours.html) for a current schedule (subject to change depending on meeting obligations).

Group work: To encourage a teamwork approach to learning we will set up study groups of four to five students each. You are encouraged to study together as a group and each group will receive a set of questions for each exam period to be answered and answers submitted at the exam. Please notify the instructor if:

- you have trouble scheduling group meeting times that include all team members
- one or more members decline to participate, and/or
- you find yourselves with fewer than 3 students in the group due to drops

Every group member is to have the opportunity to review the final answers and must participate fully in order to receive full credit for any group assignment. In-person group meetings are the best way to accomplish these goals but if attending group meetings outside of class is problematic for one or more team members, then please consider holding virtual meetings (through Skype, for example).

Text (strongly recommended): Purves, D (ed.), Neuroscience 6th edition, Sunderland, Mass: Sinauer Associates, inc., 2018, ISBN 978-1605353807. You will likely benefit by reviewing the relevant reading material in the recommended text in advance of each class. For students purchasing used texts the study guides list page numbers from both the current (6th) edition and previous (5th) editions.

Additional resources: Resources in addition to the text include the following.

- **Powerpoint slides w/notes and questions** to consider, posted in Files at least a week before class: folder/PowerPoint notes pages

- **Study guides with questions**, in Quizzes, available at least a week before the corresponding class
- **Reference materials** on electricity, links to journal articles and additional resources: in Files
- **Research paper and reading guide**, one set per exam period provided in class: copy of each guide will be posted in Files

Course grade: The final course score for Bioc/Neur 385 will be a weighted average of scores on the following items. The final grade will be based on a straight percentage. We do not grade on a curve in this course.

- Learning activities, 5%
- Homework sets, three at 10% each
- Mid-term exams, two at 20% each
- Final exam, 25%

A+, ≥ 98	B+, 87-90	C+, 77-80	D+, 67-70
A, 94-98	B, 83-87	C, 73-77	D, 63-67
A-, 90-94	B-, 80-83	C-, 70-73	D-, 60-63
			F, ≤ 60

Learning activities:

- **Learning activities** include timely completion of the tutorials and study questions in Quizzes and participation in class based upon responses to in-class quiz question. Each item (completion of one tutorial, one set of study questions, participation in one class) counts equally toward the score.
- **Each tutorial** addresses one or a few concepts related to the generation and propagation of signals by neurons, one step at a time, with each step followed by a question.
- **Study questions** are similar to the questions you will see on a homework set or exam. They have you employ higher levels of critical thinking such as analyzing a situation, applying the principles, evaluating a statement, designing an experiment, etc.
- **For in-class polling** you will need a cell phone, laptop computer, iPad, or such with access to the internet so that you can log into a cloud based audience response application called Socrative. The learning activities score for a day will be based upon percent questions answered in class. Following the first week's grace period you earn full credit for logging into Socrative and participating in the polling. A poll may come up any time during class, and for some classes the first and only poll will come at the start of class. For credit you will have to be on time.
- **Suggestions and policies.** Regardless of your background, you are likely to benefit from completing each tutorial and study question set by the due date, which for study questions is a week after the corresponding class. Your answers do not have to be correct in order to receive credit, but they should reflect a reasonable level of effort. You will receive full credit for submitting answers on time, half credit for submitting late but within the exam period, no credit for submitting after the exam period is over. You may at any time seek or give help on the study questions and other learning activities.

Homework assignments:

- **The homework sets** are designed to help you learn the major concepts, controversies, lines of reasoning, rationale behind the experiments, and significance of results, and to assess your command of the material. The questions and problems will give you the opportunity to apply the principles and strategies that you have learned from class meetings, readings, and your work on the study questions to new situations. Homework sets are intended to be both formative and summative and will be graded.

- ***Homework is to be completed entirely on your own. You must not seek or provide help on any homework question.***
- ***Suggestions for homework questions.*** For parts that require explanations, practice articulating your answers in your own words. Complete a problem or two at a time – don't wait until the last minute to complete the entire assignment. If you have trouble with a homework problem then try to take it apart. What is being asked, what information do you already have, what principles apply, what study question or questions might be relevant?
- ***Feedback.*** I will leave comments in Canvas along with itemized question scores. If you still have questions or concerns after reviewing the feedback, you are encouraged to come to my office to review your graded homework.

Exams:

- **Each exam**, including both mid-terms and the final, will consist of two parts: a group question set (20%) and the individual exam (80%).
- ***Group question set.*** About two weeks before each exam, each study group will receive a single set of four questions to be answered and submitted by the group. These questions are "open book, open notes," and the answers (to be submitted at the start of the exam) are expected to reflect a team effort.
- ***In-class midterm exams.*** Each in-class exam is "closed book, closed notes" except for notes made on your copy of the research paper. ***There is to be no collaboration on this part of the exam***. You will probably need a calculator for the first exam.
- ***Final exam.*** The final exam will be similar to the in-class midterm exams but about twice as long. Questions will come mostly from the third exam period, although a couple of questions may integrate concepts from earlier parts of the course.
- ***Questions from the primary literature.*** For each exam period each student will receive a copy of a paper from the primary literature along with a reading guide. Each set of group questions and each individual midterm exam will include a question from the reading guide (see the assignment *Research paper #1)*. The final exam may include more than one question from the third reading guide.
- ***Preparing for exams.*** Together, the study questions and homework sets will have you practice ways of thinking that will help on the exams. The exam questions, although different, will cover the same concepts and require familiar approaches to problems, so there should be no surprises. I do not test on minute details, however I will expect familiarity with terminology that I have used throughout multiple presentations and may expect you to be familiar with historically important experiments, prominent scientists, and major controversies. Prepare for each exam by reviewing the presentations, study questions/problems, and what you have learned from the related homework assignment. Meet with your study group to address any areas in which you aren't confident. Meet with the instructor to resolve any issues that remain before the day of the exam.
- ***Feedback.*** You are welcome to come to my office to look over your exam and of course to ask questions. I will write notes on the exams where appropriate. I do not return the exams or post answer keys. By the way, I do not use “exam graders.” I read through all exams once and mark tentative scores, then go back and re-check all questions to ensure consistency and fairness. There will be no need for “regrades” of exams.

Additional policies:

- ***Exams.*** I can arrange to have you take the exam at an earlier time if you will be unable to attend on the scheduled exam date due to reasons beyond your control, provided that you contact me a reasonable time in advance. I cannot reschedule an exam because you have another exam or a major assignment due in another course on the same day, nor can I give exams after the regularly scheduled time. If you miss an exam and you are unable notify me in advance, then you must provide documentation in order to make up the credit. At my discretion I will either let you take the exam, replace the missed exam with an additional assignment (possibly a different exam) or under extraordinary circumstances I may choose to omit the missed exam from your final course score. Please let me know well in advance of the first exam if you require a special arrangement due to a documented disability.
- ***Study groups.*** To encourage a teamwork approach to learning we will set up study groups of four to five students each, group assignments to be made by the instructor. Students within each group are encouraged to study together. Your study group will work together on the group exam questions.
- ***Excused absences.*** As with all of my classes, I excuse absences due to circumstances beyond your control including illness, family matters, unavoidable travel obligations, etc. I may or may not require documentation. I expect you to notify me as soon as you are aware of an obligation, such as scheduled travel, that will cause you to miss class, including events that are scheduled by the start of the semester.
- ***Late assignments.*** If you are unable to turn in a completed homework assignment at class time on the day it is due, you may submit the assignment up to 24 hours late with a 10% deduction. Because of the need to release feedback on homework sets I cannot accept assignments that are more than a day late.
- ***Students with disabilities.*** Any student with a disability needing academic adjustments or accommodations should contact me (x3498) as soon as possible and also contact Disabled Student Services in the Ley Student Center.

Topics and graded assignments

This schedule lists only the topics to be covered and corresponding notes pages (posted in the PowerPoint notes pages folder in the Files section). The notes pages are strictly intended to help you prepare for class and follow the discussion. They are no substitute for attending class. Please see the "Introduction to the study guides" (Quizzes) for a recommended approach to studying neuroscience and consult the daily study guides for recommended readings, supplemental resources, study questions, and learning objectives for each topic. This schedule may change depending on the pace at which we make it through the topics.

Monday 20 Aug – Course introduction; Biological basis of behavior (01_Intro_F18.pdf).
Wednesday 22 Aug – Animal electricity (02_AnimElec_F18.pdf)
Friday 24 Aug – Testing the Bernstein hypothesis (03_Testing_F18.pdf).
Monday 27 Aug – Discovering the diffusion potential (04_Discovering_F18.pdf)
Wednesday 29 Aug – Ionic basis of an action potential (05_IonicBasis_F18.pdf)
Friday 31 Aug – Conduction of the nerve impulse (06_Conduction_F18.pdf)
Copies of research paper #1 will be passed out today

Monday 3 Sep **LABOR DAY HOLIDAY (NO CLASSES)**

Wednesday 5 Sep – previous topic continued
Friday 7 Sep – Channel function (07_ChanFunc_F18.pdf)
***Monday* 10 Sep** –Discovering the sodium pump (08_NaPump_F18.pdf)

Wednesday 12 Sep – Studying channel structure (09_ChanStruct_F18.pdf)
Friday 14 Sep – previous topic continued
Each group receives one copy of the group questions for midterm exam 1 today

Monday 17 Sep – A diversity of ion channels (10_ChanDiversity_F18.pdf)
Wednesday 19 Sep – Introduction to synaptic transmission (11_SynTran_F18.pdf)
Wednesday 19 Sep – upload HW set #1 by noon today

Friday 21 Sep – Pre-synaptic mechanisms: role of calcium ions (12_PresynCa_F18.pdf)
Monday 24 Sep – Quantal release and the vesicle hypothesis (13_VesHyp_F18.pdf)
Wednesday 26 Sep – previous topic continued

Friday 28 Sep – Midterm exam 1 – in class – will cover material up to and including the introduction to synaptic transmission; group question set is to be turned in at the start of the exam
Please pick up your copy of research paper #2 when you turn in the exam

Monday 1 Oct – Postsynaptic membrane potentials (14_PostSyn_F18.pdf)
Wednesday 3 Oct – Synaptic plasticity in *Aplysia* (15_Aplysia_F18.pdf)
Friday 5 Oct – previous topic continued

Monday & Tuesday 8-9 Oct **MIDTERM RECESS (NO CLASSES)**

Wednesday 10 Oct – Long term synaptic plasticity (16_LTSynPlast_F18.pdf***)***
Friday 12 Oct – previous topic continued
Each group receives one copy of the group questions for midterm exam 2 today

Monday 15 Oct – Somatosensory system (17_SomatoSens_F18.pdf)
Wednesday 17 Oct – Proprioception (18_Proprioception_F18.pdf)
Friday 19 Oct – previous topic continued
Friday 19 Oct – upload HW set #2 by noon today

Monday 22 Oct – Detecting auditory signals (19_Hearing1_F18.pdf)
Wednesday 24 Oct – previous topic continued

Friday 26 Oct – Midterm exam 2 – in class – will cover pre-synaptic mechanisms through proprioception – no material on hearing; group question set is to be turned in at the start of the exam
Please pick up your copy of research paper #3 when you turn in the exam

Monday - Friday 29 Oct to 2 Nov – Encoding auditory signals (20_Hearing2_F18.pdf)
Monday 5 Nov – Vestibular system (21_Vestibular_F18.pdf)
Wednesday 7 Nov thru Wednesday 14 Nov – Vision (22_Vision1_F18.pdf, 23_Vision2_F18.pdf, 24_Vision3_F18.pdf)
Friday 16 Nov – Pain and temperature detection/perception (25_Pain_F18.pdf)
Each group receives a copy of the group questions for the final exam today

Monday 19 Nov – Chemical senses (26_ChemSense_F18.pdf)
Wednesday 21 Nov – REVIEW SESSION (optional - attendance is not required)

Thursday-Friday 22-25 Nov THANKSGIVING BREAK

Monday 26 Nov – Motor control - motor cortex (27_Movement1_F18.pdf)
Wednesday 28 Nov – Motor control - basal ganglia (28_Movement2_F18.pdf)
Friday 30 Nov – Motor control - cerebellum (29_Movement3_F18.pdf)
Friday 30 Nov – upload HW set #3 by noon today

Final exam TBA– hearing, vestibular system, vision, pain/temperature, chemical senses, plus two questions on the third research paper; group question set is to be turned in at the start of the exam

Some questions on the final exam may require skills/knowledge related to previous topics but will not focus specifically on previous topics. The final exam will be about one and one-half times as long as a mid-term exam, however you will have the full three hours in which to complete it.

Assignments labeled GRAD in the Course Summary below are for students in BIOC 585 only

Course Summary:

Date	Details	
Mon Aug 20, 2018	Introduction to the study guides (https://canvas.rice.edu/courses/14150/assignments/70660)	due by 10am
Mon Aug 27, 2018	Studyguide 1 – 20 Aug 18 (https://canvas.rice.edu/courses/14150/assignments/70656)	due by 10am
	Electricity (https://canvas.rice.edu/courses/14150/assignments/70678)	due by 11:59pm
Wed Aug 29, 2018	Equilibrium potentials (https://canvas.rice.edu/courses/14150/assignments/70657)	due by 10am
	Studyguide 2 – 22 Aug 18 (https://canvas.rice.edu/courses/14150/assignments/70686)	due by 10am
Fri Aug 31, 2018	Studyguide 3 – 24 Aug 18 (https://canvas.rice.edu/courses/14150/assignments/70659)	due by 10am
	Ion movement pt 1 (https://canvas.rice.edu/courses/14150/assignments/70672)	due by 11:59pm
Wed Sep 5, 2018	Ion movement pt 2 (https://canvas.rice.edu/courses/14150/assignments/70677)	due by 10am
	Studyguide 4 – 27 Aug 18 (https://canvas.rice.edu/courses/14150/assignments/70663)	due by 10am

Date	Details	
	Studyguide 5 – 29 Aug 18 (https://canvas.rice.edu/courses/14150/assignments/70658)	due by 10am
Fri Sep 7, 2018	Ion conductance (https://canvas.rice.edu/courses/14150/assignments/70674)	due by 10am
	Ion currents (https://canvas.rice.edu/courses/14150/assignments/70681)	due by 10am
Sun Sep 9, 2018	Sodium pump (https://canvas.rice.edu/courses/14150/assignments/70682)	due by 10pm
Wed Sep 12, 2018	Nernst and GHK (https://canvas.rice.edu/courses/14150/assignments/70679)	due by 10am
	Studyguide 6 – 31 Aug & 5 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70685)	due by 10am
	Threshold currents (https://canvas.rice.edu/courses/14150/assignments/71158)	due by 10am
Fri Sep 14, 2018	Studyguide 7 – 7 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70667)	due by 10am
Mon Sep 17, 2018	Studyguide 8 – 10 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70661)	due by 10am
Wed Sep 19, 2018	Homework set #1 (https://canvas.rice.edu/courses/14150/assignments/70690)	due by 12pm
	Homework set #1 - GRAD (https://canvas.rice.edu/courses/14150/assignments/70691)	due by 12pm
Fri Sep 21, 2018	Studyguide 9 – 12-14 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70670)	due by 10am
Mon Sep 24, 2018	Studyguide 10 – 17 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70684)	due by 10am
Wed Sep 26, 2018	Studyguide 11 – 19 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70680)	due by 10am
Fri Sep 28, 2018	Question set #1 – GRAD (https://canvas.rice.edu/courses/14150/assignments/70701)	due by 10am
	Reading guide #1 – GRAD (https://canvas.rice.edu/courses/14150/assignments/70704)	due by 10am

Date	Details	
	Research paper #1 (https://canvas.rice.edu/courses/14150/assignments/70707)	due by 10am
	Mid-term exam #1 (https://canvas.rice.edu/courses/14150/assignments/70697)	due by 10:50am
	Mid-term exam #1 - GRAD (https://canvas.rice.edu/courses/14150/assignments/70698)	due by 10:50am
Mon Oct 1, 2018	Studyguide 12 – 21 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70653)	due by 10am
Wed Oct 3, 2018	Studyguide 13 – 24-26 Sep 18 (https://canvas.rice.edu/courses/14150/assignments/70673)	due by 10am
Mon Oct 8, 2018	Studyguide 14 – 1 Oct 18 (https://canvas.rice.edu/courses/14150/assignments/70669)	due by 10am
Fri Oct 12, 2018	Studyguide 15 – 3-5 Oct 18 (https://canvas.rice.edu/courses/14150/assignments/70662)	due by 10am
Fri Oct 19, 2018	Studyguide 16 – 10-12 Oct 18 (https://canvas.rice.edu/courses/14150/assignments/70671)	due by 10am
	Homework set #2 (https://canvas.rice.edu/courses/14150/assignments/70692)	due by 12pm
	Homework set #2 - GRAD (https://canvas.rice.edu/courses/14150/assignments/70693)	due by 12pm
Mon Oct 22, 2018	Studyguide 17 – 23 Oct 18 (https://canvas.rice.edu/courses/14150/assignments/70654)	due by 10am
Fri Oct 26, 2018	Question set #2 – GRAD (https://canvas.rice.edu/courses/14150/assignments/70702)	due by 10am
	Reading guide #2 – GRAD (https://canvas.rice.edu/courses/14150/assignments/70705)	due by 10am
	Research paper #2 (https://canvas.rice.edu/courses/14150/assignments/70708)	due by 10am
	Mid-term exam #2 (https://canvas.rice.edu/courses/14150/assignments/70699)	due by 10:50am
	Mid-term exam #2 - GRAD (https://canvas.rice.edu/courses/14150/assignments/70700)	due by 10:50am
Mon Oct 29, 2018	Studyguide 18 – 17-19 Oct 18 (https://canvas.rice.edu/courses/14150/assignments/70665)	due by 10am

Date	Details	
Wed Oct 31, 2018	Studyguide 19 – 22-24 Oct 18 (https://canvas.rice.edu/courses/14150/assignments/70655)	due by 10am
Fri Nov 9, 2018	Studyguide 20 – 29 Oct-2 Nov (https://canvas.rice.edu/courses/14150/assignments/70675)	due by 10am
Mon Nov 12, 2018	Studyguide 21 – 5 Nov 18 (https://canvas.rice.edu/courses/14150/assignments/70666)	due by 10am
Wed Nov 14, 2018	Studyguide 22 – 7 Nov 18 (https://canvas.rice.edu/courses/14150/assignments/70664)	due by 10am
Mon Nov 19, 2018	Studyguide 23 – 9-12 Nov 18 (https://canvas.rice.edu/courses/14150/assignments/70687)	due by 10am
Wed Nov 21, 2018	Studyguide 24 – 14 Nov 18 (https://canvas.rice.edu/courses/14150/assignments/70683)	due by 10am
Mon Nov 26, 2018	Studyguide 25 – 16 Nov 18 (https://canvas.rice.edu/courses/14150/assignments/70676)	due by 10am
Wed Nov 28, 2018	Studyguide 26 – 19 Nov 18 (https://canvas.rice.edu/courses/14150/assignments/70668)	due by 10am
Fri Nov 30, 2018	Research paper #3 (https://canvas.rice.edu/courses/14150/assignments/70709)	due by 10am
	Studyguide 27 - 26-30 Nov 18 (https://canvas.rice.edu/courses/14150/assignments/71135)	due by 10am
	Learning activities (https://canvas.rice.edu/courses/14150/assignments/70696)	due by 10:50am
	Homework set #3 (https://canvas.rice.edu/courses/14150/assignments/70694)	due by 12pm
	Homework set #3 - GRAD (https://canvas.rice.edu/courses/14150/assignments/70695)	due by 12pm
Mon Dec 10, 2018	Question set #3 – GRAD (https://canvas.rice.edu/courses/14150/assignments/70703)	due by 10am
	Reading guide #3 – GRAD (https://canvas.rice.edu/courses/14150/assignments/70706)	due by 10am
Wed Dec 12, 2018	Final exam (https://canvas.rice.edu/courses/14150/assignments/70688)	due by 5pm

Date	Details	
	Final exam – GRAD (https://canvas.rice.edu/courses/14150/assignments/70689)	due by 5pm